

UTOGM
15/41

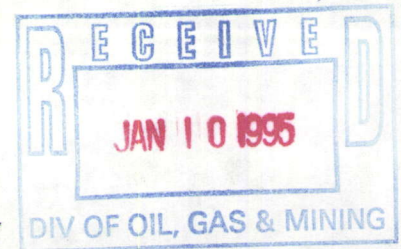
Mr. Tony Gallegas
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6 January 1995

S/015/041

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BLM San Rafael Resource Area
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3809 UTU69860 UT-067



SW/4 Section 29, T. 22 S., R. 9 E. Diamond K Gypsum Rock Quarry Emery County

VEGETATION: A plant survey was completed on the Carmel Formation gypsiferous soils. These soils have a restricted, limited flora. Atriplex confertifolia shadscale and Oryzopsis hymenoides indian rice grass are the only positive native forage plants. All other plants are considered to be opportunist weeds of limited forage potential. These opportunist weeds generally have a Eurasian origin. (Anasasi ? or Pilgrim ?)

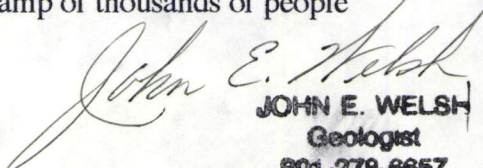
RESEEDING: The recommended BLM-UDOT seed mixture for the San Rafael Area is planted in indoor flats in the Carmel gypsiferous top soil taken from the quarry site. This test is being run under 65 degree temperature and daily watering to determine what will actually grow under ideal conditions in mon mineralogic gypsum.

The natural plant distribution in the field shows that moisture retention and slope direction controls the density of plants. South slopes are barren, small protected gullies and north slopes have maximum plant density. Flat areas maybe barren of plants or have uniform distribution of plants. The line statistical survey of plants was measured in the highest population on a flat in the SW/4 sec 29, an area to be quarried in 1995.

Artificial reseeding is of questionable value. Especially, if the seed mixture is not suitable for the mono mineralogic gypsum soils. **Transplantation** may be practical and successful for Atriplex confertifolia and Oryzopsis hymenoides. Several dozen plants were transplanted in November '94 as a test trial.

RECLAMATION: Reclamation of Area A should be designed to avoid sheet floods and rill wash caused by cloudbursts. The excavated quarry floor will have a 3 to 4 degree northwesterly inclined plane after removal of the gypsum rock. Top soil replaced upon this inclined plane should be contoured, terraced, and deeply furrowed in an EW direction. Slopes should face North to Northwest, and depressions of all varieties should be closed so as to retain moisture. North slopes and water capture are paramount to success in getting artificial and natural revegetation.

BONDING: The reclamation bond for Area A approximately 12 acres have been set at \$2,000 per acre. In the Diamond K quarry which ends up with a broad gently incline surface it is debateable as to whether the esthetics are improved over the original. The market value of marginal grazing acreage along the Moore Road, at most would be a few hundred dollars per acre. I would like to raise the question as to what is really reclamation is a semi-desert wasteland. UDOT "reclaimed" the several miles through Carmel gypsum along the interstate 70, is this the standard for the San Rafael Resource Area? I feel that BJ reclaimed prospect areas near the Moore Road had excellent to poor recovery over 15 years. It can be argued that recovery is mostly natural by what plants actually grew. It is a fact that in ten years almost any disturbed area in the West will recover to natural plant populations. In 100 years all evidence of a 1890's mining camp of thousands of people has disappeared into climax juniper and pinon.


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BOTANICAL IDENTIFICATION
GYPSUM ROCK OF THE CARMEL FORMATION
T. 22, 23 S., R. 8, 8 1/2, 9 E. SLB&M
EMERY COUNTY, UTAH

Undisturbed Flora:

<i>Oryzopsis hymenoides</i>	Indian rice grass
<i>Atriplex confertifolia</i>	Schadscale type A oval leaf Schadscale type B elongate leaf
<i>Atriplex gardneri</i> var <i>cuneata</i>	Castlevalley saltbrush
<i>Chryothamus greenii</i>	Green's rabbitbrush
<i>Chryothamus nauseosus</i> var <i>consimilis</i>	Greenish rubber rabbitbrush
<i>Lepidium montanum</i> Nutt var <i>jonesii</i>	Jones's pepperplant
<i>Phacelia rafaellensis</i>	
<i>Ephedra torreyana</i>	Mormon tea
<i>Opuntia fragilis</i>	prickly pear cactus
Introduced by reseeding in Disturbed Areas:	
<i>Agropyron desertorum</i>	crested wheat
<i>Halogeton glomeratus</i>	

ACKNOWLEDGEMENT:

Mike Windham and Loreen Allphin of the Utah Museum of Natural History compared specimens with types at the museum. Their expertise is appreciated. Dr. Stanley Welsh (BYU) and Dr. Cyrus McKell (Weber State) discussed the problems of reseeding. S. Welsh made the suggestion of transplanting only the major desired species, and letting the opportunists reseed through natural processes.

NATURAL UNDISTURBED CONDITIONS
OVERLYING GYPSUM ROCK
SAN RAFAEL RESOURCE AREA
T. 22, 23 S., R. 8, 8 1/2, 9 E.

Vegetation Survey: A vegetation survey of 5 lines of 100 feet at ten foot spacing was done in the SW/4 of the NE/4 of the SW/4 of Section 29, T. 22 S. , R. 9 E. This survey was accomplished in an area of maximum vegetation cover within Area A, the area now being actively quarried.

Within Area A, South of the Moore Road, in the NW/4 of the SW/4 of Section 29, the Ground Cover is described as

Vegetation	20%	
Litter	5%	
Rock and Frags	25%	
Bare	50%	
Revegetation at	70%	idealized at 14%

Abundant Positive Forage Plants:

<u>Atriplex confertifolia</u>	shadscale
<u>Oryzopsis hymenoides</u>	indian rice grass

Abundant Weeds:

<u>Atriplex gardneri</u>	castle valley saltbrush
<u>Chrysothamhus Greenei</u>	Green's rabbitbrush
<u>Chrysothamnus nauseosus</u>	rubber rabbitbrush
<u>Lepidium montanum</u>	Jones's pepperplant

These above plants make up 99% of the flora.

PLANT DENSITY: Plant distribution is controlled by both direction and degree of natural slopess. South facing slopes are essentially barren. Natural flat areas have well developed cryptogamic soils with both dormate and active lichen cover. Plants maybe absent from these flats increasing in gullies to a maximum on North facing slopes. Moisture availability and retention is the control for plants.

SOIL FORMATION: Soil thickness varies from none on gypsum rock to several ten feet in joints and sink holes. The A zone humic layer is absent or at best a few millimeters if the lichen growth is considered as the organic layer. The B zone is plus 75% gypsum with silt and clay derived from either overlying lithologies or blown and washed into the gypsum. The C zone is plus 80% gypsum grading into 98% gypsum rock. The impure surface layer is better named a regolith rather than "top soil"

It should be recognized that the gypsiferous "top soil" is a very restricted, inhospitable environment for most plants.

The soils on the limestone beds of the Carmel Formation are completely different from those on the gypsum rock. A cloudburst over the I-70 materials quarry near the Moore interchange produced a flash flood which carried limestone mud and clasts westward in the South Salt Wash drainage and irreversibly change the riparian environment for miles through the gypsum walled canyons. There is no way that the quarrying of gypsum rock and the bypassing of some gypsum dust, soil, or rock fragments will ever negatively effect the Salt - Wash Drainage. In fact, if it were so decided that reclamation of the South Salt Wash Drainage was desirable, then all of the reclaimed gypsiferous "top soil" should be designed to flush into South Salt Wash Drainage.

POLLENATION: It was observed while capping and filling in the plastic pipes originally used as claim markers, that one dessicated bird was found in one pipe. To offset this disaster, I wish to report that three plastic pipes have active bee hives. I was so elated to see this use of the plastic pipe, I did not have the heart to destroy the hives.

REFERENCES:

Whitson, T. D. Editor, **Weeds of the West**, revised 1992
The Western Society of Weed Science, P. O. Bx 963,
Newark, CA 94560

Stefferd, A., Editor **Grass, yearbook 1948 USDA**

Welsh, S. L., etc., **A Utah Flora, 1993 BYU**

RECOVERY THRESHOLDS FOR PLANT TYPES FOUND ON
SAN RAFAEL SWELL GYPSUM QUARRY SITE PRIOR TO
EXCAVATION ON OCTOBER 11, 1994

Eleven different plant types were found on a study area of 5000 square feet. The rates of occurrence for each type of plant were determined by running five parallel lines for 100 feet at a spacing of 10 feet, then counting the number of each type of plant within 1 foot of each reference line. A sample of each type of plant was obtained for definitive botanical identification. This report addresses the statistical significance of each rate of occurrence with the objective of establishing a reasonable recovery threshold for each plant type at a full standard deviation above its mean rate of occurrence.

RATE OF OCCURRENCE BY PLANT TYPE:

TYPE:	LINE1	LINE2	LINE3	LINE4	LINE5
- A:	7	5	4	3	3
- B:	17	19	18	20	6
- C:	1	0	0	0	0
- D:	1	0	0	0	0
- E:	5	4	3	7	1
- F:	6	9	10	8	7
- G:	0	0	0	0	1
- H:	3	2	4	4	3
- I:	3	1	2	1	2
- J:	2	3	2	4	2
- K:	9	4	8	5	4

For each of the eleven plant types, the above rates of occurrence permitted the calculation of (1) the mean rate of occurrence, (2) the standard deviation of occurrence and (3) the recovery threshold at a full standard deviation above the mean rate of occurrence. This kind of threshold should serve as a reasonable standard for assessing the recovery of each plant type found prior to excavation at this quarry site after refilling of the quarry with indigenous soil. The necessary time for the recovery of each plant type is dependent on its association with other members of the existing plant community and is not yet known, but the application of calculated recovery thresholds should permit monitoring of the appropriate time intervals. This can also permit selection of plants from other locales on the quarry property where rates of occurrence exceed established means to the

quarry site itself for transplanting until quarry site rates of occurrence achieve calculated recovery thresholds. Knowing the mean rates of occurrence can prevent overuse of available transplant stocks in otherwise undisturbed locales.

CALCULATED RECOVERY THRESHOLDS BY PLANT TYPE

PLANT TYPE:	MEAN RATE OF OCCURRENCE:	STANDARD DEVIATION:	RECOVERY THRESHOLD:
A:	4.4	1.67	6.07
B:	16.0	5.70	21.70
C:	0.2	0.45	0.65
D:	0.2	0.45	0.65
E:	3.8	2.64	6.44
F:	8.0	1.80	9.80
G:	0.2	0.45	0.65
H:	3.2	0.79	3.99
I:	1.8	0.84	2.64
J:	2.6	0.22	2.82
K:	6.0	2.34	8.34

For those plant types which have remarkably low rates of occurrence (e.g. Types C, D, and G) the simplest approach may be to transplant these away from future quarry sites then just move them back after refilling is accomplished. For instance, Type C is a small cactus which is easily recognized at any time of the year and like other commercially grown small cactuses should do well on transplanting. A 50,000 square foot quarry site is only going to have about 10 of these cactuses so it is not going to be labor intensive to move them anyway.

RESEEDING RESULTS: UDOT and BLM (recomended) 1987-

Recomended reseeding lists from UDOT and the BLM are nearly identical for the same area underlain by the Carmel Formation on the West flank of the San Rafael Swell. There are two major rock types in the Carmel Formation. The limestone terrain supports the pinon/juniper forest and its associated grasses and shrubs. There is an abrupt change from this diversified flora at a sharp boundary with the lithologic change into the gypsiferous units of the Carmel Formation.

The only species listed UDOT-BLM which grow immediately above gypsum rock are Oryzopsis hymanoides indian ricegrass and Atriplex confertifolia shadscale.

There is the very real question as to whether the UDOT-BLM recomended seed mixture has or will succeed on gypsiferous reclaimed areas. Evidence of any success of reseeding along the Interstate 70 through the gypsiferous Carmel Formation is lacking. Areas disturbed by J. Welsh along the Moore Road have been reseeded over and over in the past ten years. Some plants of Agropyron desertorum crested wheat have been established. The other plants which have reestablished themselves are those which are in the flora list derived from an on site plant count, not those on the recomended UDOT-BLM lists. It appears that natural reseeding is the successful process and artifical reseeding is an exercise in futility on the gypsiferous reclaimed areas.

RECOMENDED PRACTICE FOR RECLAMATION:

1. Surface reclaiming must be designed to avoid sheetfloods and rill wash caused by cloudbursts. Moisture retention and natural seed catchment can be accomplished by contouring and deeply furrowing the top soil so that there is no down slope movement of water. After the gypsum rock is stripped off, what results is an inclined plane with a 3 to 4 degree northwest dip. It is this plane which must be covered by the stockpiled "top soil" in such a way that water is not allowed to run off and gully the soft prepared ground.

2. With the "top soil" prepared to preserve the maximum moisture in furrows, then reseed plant only:

Oryzopsis hymanoides	indian rice grass
Atriplex confertifolia	shadscale
Agropyron desertorum	crested wheat

3. Transplant as a test:

Oryzopsis hymanoides
Atriplex confertifolia

**RECOMENDED RESEEDIDNG
CARMEL FORMATION
WEST FLANK OF THE SAN RAFAEL, EMERY COUNTY, UTAH**

AUGUST 30, 1991 BLM Office Price, Utah Certified 872-630-766

Oryzopsis hymanoides

Stipa comata

Hilaria jamesii

Atriplex confertifolia

Atriplex canescens

Ceratoides (Eurotia) lanata

Melilotus officinalis

Sphaeralcea coccinea

In addition to these species the Utah Department of Transportation reseeded a few other grasses and shrubs along Interstate U. S. 70, through the gypsiferous units of the Carmel Formation. See table below.

SEEDING SCHEDULE				
SEED NO.	NAME		LBS LIVE SEED PER ACRE	
	BOTANICAL	COMMON	METHOD A	METHOD B
GRASS				
1	BOUTELOUS GRACILIS	BLUE GRAMA	8.0	4.0
2	HILARIA JAMESII	GALLETA	1.5	2.5
3	ORYZOPSIS HYMENOIDES	INDIAN RICE GRASS	5.5	9.0
4	ORYZOPSIS HYMENOIDES	INDIAN RICE GRASS	4.0	9.0
5	SPOROBOLUS AIROIDES	ALKALI SACKTON	0.5	1.0
6	SPOROBOLUS CRYPTANDRUS	SAND DROP SEED	0.25	0.5
7	STIPA COMATA	NEEDLE AND THREAD	3.5	6.0
8	STIPA COMATA	NEEDLE AND THREAD	2.75	5.0
9	STIPA COMATA	NEEDLE AND THREAD	1.5	2.5
10	PENSTEMON SP.	PENSTEMON	1.0	2.0
SHRUBS				
13	ATRIPLEX CANESCENS	FOUR WINGED SALTBUSH	1.0	2.0
16	ATRIPLEX CONFERTIFOLIA	SHADSCALE/HOPSAGE	0.5	1.0
17	CHRYSTHANUS NAUSEOSUS	RABBIT BRUSH	0.25	0.5
19	EPHEDRA VIRIDIS	MORMON TEA	0.5	1.0
22	MAHONIA A. FREMONTII	FREMONT MAHONIA	1.0	2.0
MISC.				
23	PINUS EDULIS	PINYON PINE	1.25	2.5
25	YUCCA	YUCCA	0.75	1.25

SEEDING SCHEDULE				
SEED NO.	NAME		LBS. LIVE SEED PER ACRE	
	BOTANICAL	COMMON	METHOD "A"	METHOD "B"
1	Oryzopsis hymenoides	INDIAN RICE GRASS	5.5	9.5
2	Oryzopsis hymenoides	INDIAN RICE GRASS	4.5	9.0
3	Sporobolus airoides	ALKALI SACKTON	0.5	1.0
4	Stipa comata	NEEDLE-AND-THREAD	3.5	6.0
5	Stipa comata	NEEDLE-AND-THREAD	1.5	2.5
6	Stipa comata	NEEDLE-AND-THREAD	2.75	5.0
7	Sporobolus cryptandrus	SAND DROP SEED	0.25	0.5
8	Hilaria jamesii	GALLETA	1.5	2.5
9	Boutelous gracilis	BLUE GRAMA	0.25	0.5
10	Atriplex confertifolia	SHADSCALE	1.0	2.0
11	Atriplex confertifolia	SHADSCALE	0.5	1.0
12	Atriplex canescens	FOUR-WING SALT BUSH	1.0	2.0
13	Atriplex canescens	FOUR-WING SALT BUSH	0.5	1.0
14	Ephedra viridis	MORMON TEA	1.0	2.0
15	Ephedra viridis	MORMON TEA	0.5	1.0
16	Eurotia lanata	WINTERFAT	0.5	1.0
17	Eurotia lanata	WINTERFAT	1.0	2.0
18	Cercocarpus montanus	MOUNTAIN MAHOGANY	1.0	2.0
19	Furcia tridentata	ANTELOPE BITTERBUSH	2.0	3.0
20	Sphaeralcea globularifolia	GOODENRY GLOBE MALLOW	0.25	0.5

SOIL TEST REPORT and FERTILIZER RECOMMENDATIONS

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Logan, Utah 84322
(801) 797-2217

Name JOHN E. WELSH
Street 4780 BONAIR ST
City, State HOLLADAY, UTAH 84117
ZIP

Date 10/27/94

SAMPLE IDENT.	CROP TO BE GROWN	SOIL TEXTURE	LAB NO.
1) <u>RAFAEL</u>	<u>DESERT FLA</u>	<u>LOAM</u>	<u>1228</u>
2) _____	_____	_____	_____
3) _____	_____	_____	_____
4) _____	_____	_____	_____

Copy sent to Extension office
in SALT LAKE County.

SOIL TEST RESULTS	Very Low	Low	Adequate/Normal	High	Very High	RECOMMENDATIONS	Notes
NITRATE-NITROGEN N ppm	1) _____ 2) _____ 3) _____ 4) _____	N recommendations are based on your crop and fert. history. A valid test for N requires special sampling procedures.				<u>0</u> N lbs/A	<u>a</u>
PHOSPHORUS P ppm	1) <u>2.3 ***</u> 2) _____ 3) _____ 4) _____			<u>high rainfall</u> <u>desert</u>		<u>150-170</u> <u>50-70</u> P ₂ O ₅ * lbs/A	<u>b, c, d</u>
POTASSIUM K ppm	1) <u>44 *****</u> 2) _____ 3) _____ 4) _____					<u>0</u> K ₂ O* lbs/A	
SALINITY EC _e mmhos/cm	1) <u>10.4 *****</u> 2) _____ 3) _____ 4) _____						<u>e</u>
pH	1) <u>8.0 *****</u> 2) _____ 3) _____ 4) _____						<u>f</u>
LIME	1) <u>++ *****</u> 2) _____ 3) _____ 4) _____						
) _____							
) _____							

NOTES:

* P₂O₅ x .45 = P K₂O x .82 = K

- We do not have enough data to give a reliable recommendation for N fertilizer.
- This P recommendation is for normal crop production plus substantial buildup for future crops. Retest after 2 years.
-
- See Note 6 on reverse.
- See Note 10b on reverse.
- At this sample's salinity level, this pH value indicates a probable sodium problem. Consult local Extension or SCS office or this lab before fertilizers are applied.

For further assistance, please contact Jan at the Lab

You may need to modify these recommendations in order to achieve maximum economic return under your specific conditions of weather, finances and management.



N. 75 E. Strike gully in center of NE/4 of SW/4 section 29, Area A, claim BJ - 2
 Difference is vegetation density on North facing and South facing slopes.
 At the level of the surveyor the N and S slopes overlie gypsiferous siltstones.
 Gypsum rock is above the red siltstone marker in the background.
 This gully is the 1,000 foot long tributary of South Salt Wash in the middle of section 29.



NE/4 of the SE/4 of section 30, claim BJ-9
 Revegetation Example, approximately 10 years of recovery, reseeded at least three (3) times with BLM-UDOT recommended seed mixture plus Agropyron desertorum.
 This is an example of the maximum vegetation density on a level to slightly undulating surface. Revegetated area is on the viewer's right. There are two well recovered areas, including this one where an investigator may either verify or negate the successful regrowth of the BLM-UDOT seed mixture.

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SW/4 of the NE/4 of the SW/4 section 29, Area A, claim BJ-2
Cryptogamic soil - lichen film overlying zero feet to one foot B and C zones of gypsiferous soil. This highly gypsiferous soil overlies 95% purity gypsum rock. Minimum grass and shrub flora on a typical flat surface.



SW/4 of the NE/4 of the SW/4 section 29, Area A, claim BJ-2
Cryptogamic Soil - lichen film overlying zero feet to one foot of B and C zones of gypsiferous soil, directly above 95% purity gypsum rock. An example of the maximum grass and shrub flora on a typical flat surface. This is the area of plant statistical count and of plant identification.

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